

CLAIMS

1. An exposure apparatus which exposes a substrate by radiating an exposure light beam onto the substrate through a liquid, the exposure apparatus comprising:

a mover which is capable of holding the substrate;

an interferometer system which radiates a measuring light beam onto a reflecting surface formed on the mover and which receives a reflected light beam therefrom to measure position information about a position of the mover; and

a memory which stores, as first information, error information about an error of the reflecting surface obtained in the presence of the liquid supplied onto the mover.

2. The exposure apparatus according to claim 1, wherein the memory stores, as second information, error information about an error of the reflecting surface obtained in the absence of the liquid supplied onto the mover.

3. The exposure apparatus according to claim 2, further comprising a control unit which controls the position of the mover on the basis of the first information and the position information measured by the interferometer

system in the presence of the liquid supplied onto the mover, and which controls the position of the mover on the basis of the second information and the position information measured by the interferometer system in the state in which the liquid is not supplied onto the mover.

4. The exposure apparatus according to claim 3, wherein the first information and the second information include correction information to control movement of the mover by compensating the error of the reflecting surface.

5. The exposure apparatus according to claim 3, wherein the control unit controls the position of the mover on the basis of the first information and the position information measured by the interferometer system when the substrate is exposed, and the control unit controls the position of the mover on the basis of the second information and the position information measured by the interferometer system when a plurality of marks on the substrate are detected.

6. The exposure apparatus according to claim 1, wherein the error of the reflecting surface includes a warpage of the reflecting surface.

7. The exposure apparatus according to claim 1,

wherein the error of the reflecting surface includes an inclination of the reflecting surface.

8. The exposure apparatus according to claim 1, wherein the reflecting surface is formed substantially in a first direction, and the first information includes a plurality of pieces of information corresponding to a plurality of positions in a second direction substantially perpendicular to the first direction.

9. The exposure apparatus according to claim 8, wherein the mover has a second reflecting surface which extends in the second direction, and the first information includes error information about an error of the second reflecting surface.

10. The exposure apparatus according to claim 9, wherein the first information includes a plurality of pieces of information corresponding to a plurality of positions in the first direction, as the error information about the error of the second reflecting surface.

11. The exposure apparatus according to claim 1, wherein the mover has a first reflecting surface and a second reflecting surface which is substantially perpendicular to the first reflecting surface, and the

first information includes a plurality of pieces of information corresponding to positions of the liquid on the mover, as error information about an error of the first reflecting surface and error information about an error of the second reflecting surface.

12. The exposure apparatus according to claim 1, wherein the mover has a first reflecting surface and a second reflecting surface which is substantially perpendicular to the first reflecting surface, and the first information includes orthogonality error information about an error of orthogonality between the first reflecting surface and the second reflecting surface.

13. An exposure apparatus which exposes a substrate by radiating an exposure light beam onto the substrate through a liquid, the exposure apparatus comprising:

a mover which holds the substrate;

a driving unit which moves the mover; and

a control unit which controls the driving unit and which includes first control information for moving the mover in the presence of the liquid supplied onto the mover, and second control information for moving the mover in the absence of the liquid supplied onto the mover, wherein the control unit controls the driving unit.

14. The exposure apparatus according to claim 13, wherein the first control information corresponds to a position on the mover, of a liquid immersion area formed on the mover.

15. The exposure apparatus according to claim 13, further comprising:

an interferometer system which radiates a measuring light beam onto a reflecting surface formed on the mover and which receives a reflected light beam therefrom to measure position information about a position of the mover, wherein:

the first control information and the second control information include information about an error of the reflecting surface.

16. The exposure apparatus according to claim 13, further comprising a measuring system which performs measurement on the mover, wherein a position of the mover is controlled based on the second control information when the measurement is performed with the measuring system.

17. The exposure apparatus according to any one of claims 1 to 16, further comprising a projection optical system, wherein the exposure light beam is radiated onto the substrate via the liquid and the projection optical

system.

18. A position control method for controlling a position of a mover by using a reflecting surface formed on the mover which holds a substrate in an exposure apparatus for exposing the substrate by radiating an exposure light beam onto the substrate through a liquid, the position control method comprising:

measuring error information about an error of the reflecting surface in the presence of the liquid supplied onto the mover; and

controlling the position of the mover on the basis of the error information.

19. The position control method according to claim 18, wherein the error of the reflecting surface includes a warpage of the reflecting surface.

20. The position control method according to claim 18, wherein the error of the reflecting surface includes a inclination of the reflecting surface.

21. The position control method according to claim 18, wherein the error information about the error of the reflecting surface is measured in a state in which the substrate is held on the mover.

22. The position control method according to claim 21, wherein a surface of the substrate held on the mover when the error information about the error of the reflecting surface is measured has a contact angle with respect to the liquid, the contact angle being substantially same as a contact angle with respect to the liquid of a surface of the substrate as an exposure objective to be irradiated with the exposure light beam.

23. The position control method according to claim 18, wherein a position of a liquid immersion area on the mover is changed accompanied with movement of the mover, and the error information about the error of the reflecting surface is measured a plurality of times while changing the position of the mover.

24. The position control method according to claim 18, wherein the reflecting surface is formed on the mover substantially in a first direction, and the error information about the error of the reflecting surface is measured while moving the mover to a plurality of positions in a second direction substantially perpendicular to the first direction.

25. The position control method according to claim

24, wherein a plurality of measuring beams, which are substantially in parallel to the first direction, are radiated onto the reflecting surface from an interferometer system which measures position information about the position of the mover during movement of the mover in the second direction, and reflected light beams from the reflecting surface are received to measure the error information about the error of the reflecting surface on the basis of a light-receiving result.

26. The position control method according to claim 18, wherein error information about an error of the reflecting surface is measured in the absence of the liquid supplied onto the mover.

27. The position control method according to claim 26, wherein the error information about the error of the reflecting surface is measured in the absence of the liquid supplied onto the mover, and then the liquid is supplied onto the mover so that the error information about the error of the reflecting surface is measured in the presence of the liquid supplied onto the mover.

28. The position control method according to any one of claims 18 to 27, wherein the exposure light beam is radiated onto the substrate via the liquid and a projection

optical system in the exposure apparatus.

29. A method for producing a device, comprising using the position control method as defined in claim 18.

30. An exposure apparatus which exposes a substrate by radiating an exposure light beam onto the substrate through a liquid, the exposure apparatus comprising:

an exposure station in which the exposure light beam is radiated onto the substrate through the liquid;

a measuring station which is provided with a measuring system and in which the substrate is measured and exchanged;

a mover which is movable between the exposure station and the measuring station while holding the substrate;

a driving unit which moves the mover; and

a control unit which controls the driving unit and which includes first control information for moving the mover in the presence of the liquid supplied onto the mover, and second control information to move the mover in the absence of the liquid supplied onto the mover, wherein:

an exposure is performed for the substrate through the liquid while controlling movement of the mover on the basis of the first control information when the mover is disposed in the exposure station, and measurement is performed while controlling the movement of the mover on the basis of the

second control information when the mover is disposed in the measuring station.

31. The exposure apparatus according to claim 30, wherein the measurement is performed in the absence of the liquid supplied in the measuring station.

32. The exposure apparatus according to claim 30, wherein the mover has a plurality of stages.

33. The exposure apparatus according to claim 32, wherein the plurality of stages include reflecting mirrors respectively, and the first control information and the second control information include error information about an error of each of the reflecting mirrors.

34. An exposure apparatus which exposes a substrate by radiating an exposure light beam onto the substrate through a liquid, the exposure apparatus comprising:

an optical member through which the exposure light beam passes;

a mover which is movable on a light-outgoing side of the optical member;

an interferometer system which radiates a measuring light beam onto a reflecting surface formed on the mover and which receives a reflected light beam therefrom to

measure position information about a position of the mover;
and

a memory which stores, as first information, error information about an error of the reflecting surface obtained in the presence of a liquid immersion area formed on the mover.

35. The exposure apparatus according to claim 34, wherein the memory stores, as second information, error information about an error of the reflecting surface obtained in the absence of the liquid immersion area formed on the mover.

36. The exposure apparatus according to claim 34, wherein the mover is movable while holding the substrate.

37. The exposure apparatus according to claim 34, wherein:

the reflecting surface is formed substantially in a first direction; and

the mover is moved to a plurality of positions in a second direction perpendicular to the first direction to obtain error information about an error of the reflecting surface at each of the plurality of positions in the second direction.

38. The exposure apparatus according to claim 34, wherein:

the reflecting surface is formed substantially in a first direction; and

the error information about the error of the reflecting surface is measured while moving the mover in the first direction.

39. A method for producing a device, comprising using the exposure apparatus as defined in any one of claims 1, 13, 30, and 34.

40. An exposure method for exposing a substrate by projecting an image of a pattern onto the substrate through a liquid, the exposure method comprising:

holding the substrate or a dummy substrate on a mover provided with a reflecting surface onto which a measuring light beam for positional measurement is radiated;

determining error information about an error of the reflecting surface in the presence of the liquid supplied onto the mover; and

projecting the pattern image onto a predetermined position on the substrate through the liquid on the basis of the error information.

41. The exposure method according to claim 40,

further comprising detecting a mark formed on the substrate without supplying the liquid onto the substrate to obtain alignment information about the substrate.

42. The exposure method according to claim 41, further comprising determining error information about an error of the reflecting surface without supplying the liquid onto the substrate, wherein the alignment information is obtained while controlling the position of the mover on the basis of the determined error information.

43. The exposure method according to claim 40, further comprising performing a measurement process during which the liquid is being supplied onto the mover, while controlling the position of the mover on the basis of the error information about the error of the reflecting surface.

44. The exposure method according to claim 43, further comprising exchanging the substrate after completion of exposure for the substrate, wherein the error information about the error of the reflecting surface is determined by radiating the measuring light beam onto the reflecting surface when the substrate is exchanged.

45. The exposure method according to claim 44,

wherein only in a case a lot of the substrate is changed, the error information about the error of the reflecting surface is determined in exchanging the substrate.